REMARKS

By this amendment, applicants have amended the Brief Description of the Drawings to change "Figure 4" to read --Figures 4(a)-4(f)-- as required by the Examiner in numbered section 1 of the Office Action.

Applicants have also amended the claims to more clearly define their invention. In particular, claim 1 has been amended to include therein the limitation previously recited in dependent claim 2. Applicants have canceled claims 2, 3, 5, 8 and 9 without prejudice or disclaimer and amended claims 4 and 6 to depend from claim 1. Applicants have also added claims 10-21 to further define their invention.

Claims 1-7 stand rejected under 35 U.S.C 103(a) as being unpatentable over JP-2000-252359 to Fukazawa in view JP-03-330278 (sic - JP-08-330278?) to Nakagawa. Applicants traverse this rejection and request reconsideration thereof.

Initially, it appears the form PTO-1449 submitted with the subject application contained a typographical error with respect to the document number of Nakagawa. That is, while the original form PTO-1449 listed Nakagawa as 03-330278. The correct document number is 08-330278. Applicants are submitting a corrected form PTO-1449 correcting the document number of Nakagawa et al. It is requested that the Examiner initial and substitute the attached form PTO-1449 for the form PTO-1449 submitted with the filing of the subject application. The following remarks presume the correct Nakagawa reference to be JP-08-330278.

The present invention relates to an etching method for etching a sample including an organic insulating film. For example, the etching method can be used for forming a trench having a prescribed depth in an organic insulating film without using an etching stopper layer. The method includes generating a plasma from a mixed gas containing hydrogen and nitrogen or ammonia. According to the present

invention, the light emission spectral intensity ratio between cyan molecule and hydrogen atom in the plasma is measured. The process is then controlled to enhance the light emission spectral intensity of hydrogen atom to not less than the light emission spectral intensity of cyan molecule. According to claim 1, the etching process is carried out while keeping the measured value at a light emission spectral intensity ratio CN/H at 1 or less. According to the claim 10, the mixing ratio of the mixed gas is controlled to enhance the light emission spectral intensity ratio, while, according to claim 16, the flux of the hydrogen gas is controlled to enhance the light emission spectral intensity ratio.

The Fukazawa document discloses a method in which an insulating film including an organic dielectric film is etched and worked quickly without forming a damage layer and without lowering throughput. The English language abstract of this document indicates that when the organic dielectric film part 12 is etched and worked, it is etched using ions or radicals which contain an NH group and which are generated by a gas discharge in a mixed gas of hydrogen gas and nitrogen gas or in a mixed gas of ammonia gas. It is further disclosed that while a reaction product containing a CN group is produced, the insulating film is etched, and an opening or the like is formed.

While the Examiner refers to Figure 5b of this document, this figure does not appear to show enhancing the light emission spectral intensity of hydrogen atom to not less than the light emission spectral intensity of cyan molecule. To the contrary, it appears the peak for CN is greater than that for H in Figure 5b. The Examiner also refers to Figure 6, which shows a broad range of $H_2/(H_2+N_2)$ values and corresponding emission spectral intensity ratios of each of CN, NH, N_2, CH and H. While the Examiner admits Fukazawa does not teach that the light emission spectral

intensity ratio CN/H is 1 or less, the Examiner alleges the broad range of $H_2/(H_2+N_2)$ values includes some for which the light emission spectral intensity ratio CN/H is 1 or less. While there may randomly be some values of $H_2/(H_2+N_2)$ for which the light emission spectral intensity ratio CN/H is 1 or less, clearly there is no suggestion in Fukazawa to control the process to enhance the light emission spectral intensity of hydrogen atom to not less than the light emission spectral intensity of cyan molecule. That is, Fukazawa does not suggest the subject matter of claim 1 in which the etching process is carried out while keeping the measured value at a light emission spectral intensity ratio CN/H at 1 or less. Fukazawa also does not suggest the subject matter of claim 10 in which the mixing ratio of the mixed gas is controlled to enhance the light emission spectral intensity ratio, or the subject matter of claim 16 in which the flux of the hydrogen gas is controlled to enhance the light emission spectral intensity ratio.

An object of the present invention is to provide an etching method of an organic insulating film which makes it possible to perform etching while preventing the phenomenon of microtrenching (sometimes called "sub-trenching"). The inventors examined various ways for preventing microtrenching and found that microtrenching can be prevented by controlling the etching process to enhance the light emission spectral intensity of hydrogen atom to not less than the light emission spectral intensity of cyan molecule. According to claim 1, the etching process is carried out while keeping the measured value at a light emission spectral intensity ratio CN/H at 1 or less. According to the claim 10, the mixing ratio of the mixed gas is controlled to enhance the light emission spectral intensity ratio, while, according to claim 16, the flux of the hydrogen gas is controlled to enhance the light emission spectral intensity ratio. The Fukazawa document does teach to solve this problem in

the manner presently claimed. Therefore, it would not have been obvious to modify Fukazawa to arrive at the presently claimed invention.

Moreover, the presently claimed invention achieves unexpectedly advantageous results. That is, by controlling the etching process to enhance the light emission spectral intensity of hydrogen atom to not less than the light emission spectral intensity of cyan molecule, microtrenching is prevented, as shown in Figure 9, Table 1 on page 19 of applicants' specification and as described in the paragraph bridging pages 22 and 23. Such is neither disclosed nor suggested by Fukazawa.

The Examiner has cited the Nakagawa document as teaching controlling the etching process such that a light emission intensity ratio remains constant. However, the Nakagawa document teaches controlling the etching process such that a light emission intensity ratio of CF_2/F remains constant. There does not appear to be any suggestion to control the etching process to enhance the light emission spectral intensity of hydrogen atom to not less than the light emission spectral intensity of cyan molecule, as presently claimed. Accordingly, the presently claimed invention is patentable over the proposed combination of Fukazawa and Nakagawa.

Claims 8-9 stand rejected under 35 U.S.C 103(a) as being unpatentable over JP-2000-252359 to Fukazawa in view JP-03-330278 (sic - JP-08-330278?) to Nakagawa and further in view of US Patent No. 6,080,529 to Ye et al. Applicants traverse this rejection and request reconsideration thereof.

The Ye et al patent discloses a first embodiment that pertains to a method of patterning a semiconductor device conductive feature while permitting easy removal of any residual masking layer which remains after completion of the etching process. And a second embodiment that pertains to a specialized etch chemistry useful in the patterning of organic polymeric layers such as low k dielectrics, or other organic

polymeric interfacial layers. The Ye et al patent discloses that the preferred etch plasma is a hydrogen/nitrogen-based plasma, wherein the principal etchant species is hydrogen, or nitrogen, or a combination thereof and that it is also possible to use a hydrocarbon-based plasma for etching of the high temperature organic polymeric material, the hydrocarbon-based plasma optionally including a lesser amount of a component selected from the group consisting of ammonia, hydrogen, nitrogen, and combinations thereof.

However, nothing in Ye et al remedies the basic deficiency of the proposed combination of Fukazawa and Nakagawa. That is, Ye et al does not suggest controlling the etching process to enhance the light emission spectral intensity of hydrogen atom to not less than the light emission spectral intensity of cyan molecule. Accordingly, the presently claimed invention is patentable over the proposed combination of Fukazawa, Nakagawa and Ye et al.

In response to the rejection of claims 1-9 under the judicially created doctrine of obviousness type double patenting, applicants are submitting herewith a timely filed terminal disclaimer in compliance with 37 CFR 1.321(c). Applicants are filing the terminal disclaimer to advance the prosecution of the application. The filing of the terminal disclaimer is not an admission of the propriety of the rejection.

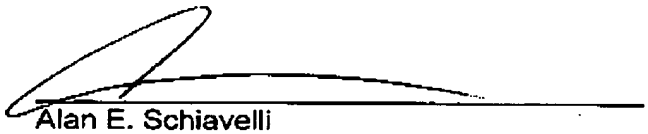
In view of the foregoing amendments and remarks, favorable reconsideration and allowance of all of the claims now in the application are requested.

Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry,

Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 500.41254CX1), and please credit any excess fees to such deposit account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP



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Attachments